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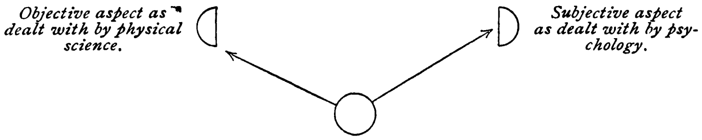
THE MONIST.

THE PHILOSOPHY OF EVOLUTION.

IN SO DIFFICULT a quest as that on which we are engaged in these essays—nothing less than the search for a consistent theory of thought and things in which the claims of science and of metaphysics shall be carefully distinguished and assessed at their true value—occasional recapitulation is not only admissible but desirable.

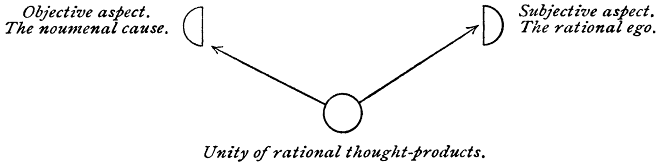
At the outset we took our stand on the realities of experience. Dealing chiefly with sensory impressions, we contended that their objective aspect, in the phenomena of the world around us, has a reality and a validity which are their inalienable right as facts of experience. The scent, color, form, and position of the bunch of violets, which lay before me, were regarded, in all their minutest details, as realities of experience. But this insistence on the reality of the objective aspect involved no denial of the correlative subjective reality of every sensory impression and of all experience. The plain man, without troubling his head about object or subject, accepts a rough and ready, but quite serviceable, classification of the data of experience into the external things and occurrences in the world around him, and the ideas and emotions which they call forth in himself. The student of physical science, looks outwards and devotes his attention to the nature and sequence of objective phenomena, with only tacit reference to their subjective aspect in consciousness. The psychologist on the other hand looks inwards and deals primarily with the nature and sequence of mental states, regarding physical phenomena as products in and for consciousness. It is almost inevitable that both the physicist on the one hand and the psychologist on the other, should magnify his office; that the one should regard the objective phenomena as primary, and the states of consciousness secondary, while the other assumes a point of view from which the order appears to be reversed, states of consciousness being primary and their phenomenal products secondary. Our purpose was to show that their respective claims are, if due allowance be made for such diverse attitudes, of strictly co-ordinate validity. Starting from the unity of sensory experience we contended that the two aspects, objective and subjective, were the products of analysis. To put the matter in diagrammatic form we have the following scheme:


Objective aspect as dealt with by physical science.
Subjective aspect as dealt with by psychology.

Unity of sensory experience.

Thus we reach analytic dualism as the result of the polarisation of the monistic unity of sensory experience. And it was urged that to regard the phenomena with which physical science is occupied as primarily states of consciousness is not so much false in fact as erroneous in method. It is the result of looking at experience through the spectacles of psychology.

But experience, even when supplemented by the expectations justifiably founded thereon, presents us merely with sequences, observed, remembered, or anticipated. No inductive process dealing with these data, and these alone, can give rise to generalisations concerning their causal connexions or concerning the continued persistence of the occasions of sensory experience. These are the metaphysical importations of our rational thought—the postulates of reason. If the physicist speaks of cause as the *raison d'être* of phenomenal sequence he is dealing with this noumenal existence in its objective aspect. If the psychologist speaks of the subjective activity of the mind, or ego, as underlying and giving connexion to the sequence of states of consciousness, he too is dealing with noumenal existence. By an extension of analytic dualism into the metaphysical sphere the unity of rational thought assumes its dual aspect. Expressing this as before in diagrammatic form, we have the following scheme:



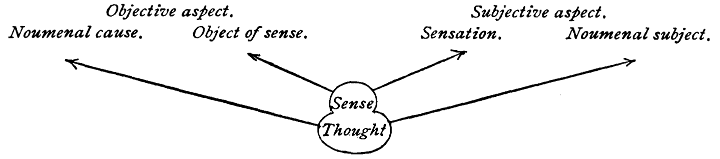
If now we superimpose upon this scheme that given above, we have the noumenal reality (for thought) underlying the phenomenal reality (of sensory experience).

We must therefore, in view of this extended scheme, understand by *experientia est* the existence, not only of sensory experience, but also of rational thought. Herein analysis distinguishes two aspects, the objective and the subjective. And we may perhaps be enabled, through this conception of analytic dualism, to perceive how it comes about that the philosophical biologist, looking at the matter through objective spectacles, sees in experience the outcome of organic evolution; while the philosophical psychologist, looking at the matter through subjective spectacles, sees in experience the product of the individual mind, and exclaims with Descartes, *Cogito.* Genetically *experientia est* has precedence over his dictum; since self-consciousness is a late product of evolution. From the point of view of the philosopher of Descartes's time, however, genetic considerations had scarcely emerged into the light of thought. For him, and for us too apart from evolution, the *cogito* is primary, since it is the ego which alone gives unity and continuity to experience. Both Cartesian and evolutionist may well be right, though they approach the problem of experience from such different directions. We have at present, however, no concern with psychology or the ego. Their consideration must be reserved for a later essay. It is the philosophy of evolution to which we have now to direct our attention.

How necessary a philosophy of evolution is to supplement the hypothesis of analytic dualism will be evident if we revert for a moment to what was said in the last essay concerning J. S. Mill's permanent possibilities of sensation. It was there urged that the permanence is a metaphysical assumption. In reply to this it may be said that the permanence is an inference from the direct teachings of experience. For what is permanence but the absence of change? But every change in the physical world has its assignable antecedents. I pass the mile-stone on the Dover road and expect to find it there to-morrow. Why? Because, in the absence of any such conditions as may determine its disappearance, there are no antecedents of change. This permanence, therefore, when no cause of change can be shown, is an essentially scientific conception. Persistence, to give it another name, lies at the root of the indestructibility of matter and the conservation of energy. The plain common sense of the matter, it will be urged, is that for any physical change, physical antecedents can be discovered. And this is the direct teaching of experience. To which, I reply, that with all this I am in substantial agreement. No doubt experience warrants the expectation of finding the mile-stone, in the absence of physical antecedents of change, still there unaltered; no doubt such expectations are abundantly justified. I have said as much myself. But I understand Mill's "permanent possibility of sensation" to carry with it the implication of continuity of existence independently of all experience. Whether actually an object of sensation or not, there it remains, at present outside experience, but ready to be perceived at any moment. And I still fail to see in what way sensory experience can afford the data for the establishment of any induction concerning the permanence of that which only occasionally swims into its ken. We are forced to admit that the continuous existence of something beyond our senses is a fundamental postulate of reason—a metaphysical assumption justifiable because it so admirably fits and renders explicable the facts of sensory experience.

How then does this conception of an independent existence fit in with the conception of analytic dualism? Granted that it is a reality for thought. Have we really gone further than asserting that the permanent possibility of sensation is a permanent possibility of thought? Suppose that no one thinks of it. Is it not then every whit as much outside the extended experience which includes thought, as the unseen mile-stone is outside the limited experience of sensory impressions? If experience is the measure of existence continuity must ever remain as a possibility beyond immediate verification. This is, I think, undeniable. And the philosopher admits as much in contending that the continuity of existence is a postulate of rational thought.

The insufficiency of analytic dualism may be exhibited in another way. Let us illustrate it again in diagrammatic form:



Here the analysis of sensory experience gives, on the one hand, the object of sense, and, on the other, the sensation in consciousness; while the analysis of thought gives the noumenal cause underlying the object of sense, and the noumenal subject underlying the conscious sensation. But there is apparently no indication in the scheme of any mode of interaction between the noumenal cause and the noumenal subject with the phenomena of sense as intermediaries. If object and subject are merely distinguishable aspects of a monistic unity, how can this unity be regarded as in any sense the product of their interaction? How can the origin of an experience susceptible of such analysis be explained? The answer to these questions can only be found through an appeal to the philosophy of evolution which may afford us a supplementary hypothesis. To this, therefore, we must now turn.

"Evolution," according to Mr. Herbert Spencer's formula, "is an integration of matter and a concomitant dissipation of motion; during which the matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity; and during which the retained motion undergoes a parallel transformation." I cannot approach the consideration of the philosophy of evolution without a passing tribute to the genius of Mr. Herbert Spencer. When we remember the time at which he wrote his germinal essay on *Progress: Its Law and Cause*, when evolution was not the watchword which for men of science it has since become, when the conservation of energy was not yet definitely formulated and the *Origin of Species* was still unwritten, or at least not yet published, when scientific knowledge was the possession of the few and such views as Mr. Spencer advocated were damned with the stigma of unorthodoxy; when we remember all this, we must, in common justice, admit that the broad sweep and firm grasp of his unifying conception marked an epoch in the history of scientific thought. It is true that, in a students' debating society to-day, a newly-fledged physicist or biologist may sharpen his critical teeth on this or that statement in the *First Principles* or the *Principles of Biology.* It is good for them to do so. Strange would it be if half a century of scientific specialism had found no flaw in the work of one whose comprehensive intellect took the whole sphere of knowledge for its province. The wonder is that so much has stood the test of an ordeal so searching. All honor be to him whose informing and inspiring work has left an indelible impress upon his age.

In the "Westminster" article of 1877, wherein is to be found the germ of his evolutionary doctrine, after saying that "the investigations of Wolff, Goethe, and von Baer have established the truth that the series of changes gone through during the development of a seed into a tree, or an ovum into an animal, constitute an advance from homogeneity of structure to heterogeneity of structure" through a series of differentiations, Mr. Spencer continues as follows: "Now, we propose in the first place to show, that this law of organic progress is the law of all progress. Whether it be in her development of the earth, in the development of life upon its surface, in the development of society, of government, of manufacture, of commerce, of language, literature, science, art, this same evolution of the simple into the complex, through successive differentiations, holds throughout. From the earliest traceable cosmical changes, down to the latest results of civilisation, we shall find that the transformation of the homogeneous into the heterogeneous, is that in which progress essentially consists."

Mr. Spencer here strikes clearly and firmly one of the key-notes of the harmonic process of development. The root-ideas of the conception of evolution are, first differentiation, and secondly the interaction of the differentiated products. How the initial differentiation arose we do not know. Pry as far as we can into the past with the telescope of speculation assisted by the kinematoscope of imagination, and we find differentiation already established. Assuming, with the nebular hypothesis, a primitive fire-mist, we must assume also an environment from which it is already differentiated and to which its heat energy is communicated by radiation. Or if we accept the meteoric hypothesis, we must grant the existence of already differentiated cosmic dust and the interaction of its constituent meteors. If we give yet freer rein to the speculative tendency, which, chastened or running riot, is man's blessing or curse, and, straining our mental vision, search deeper still into the beginnings of our universe, to find in the homogeneous substance that Sir Wm. Crookes calls *protyle*, the stuff from which the chemical elements were differentiated; even in this dim and wholly hypothetical region we are forced to assume, as the antecedent conditions of differentiation, transformations and redistributions of energy, implying a prior differentiation to render such interaction conceivable. Or if, once more, we conceive the elemental atoms as vortex rings, differentiated from the ether and thenceforth interacting, even here at the very threshold of differentiation, we seek for an answer to the question: Under what physical conditions did such vortex motion originate? Nor is this baffling of the speculative reason to be wondered at. The search for origin in terms of antecedence and sequence must ever be illusory. For if we assume, in accordance with the axiom of physical causation, that every change in a material system has antecedent conditions, the assumption involves a retrogression which is endless. For every group of antecedent conditions is itself the outcome of a prior antecedent. It is only through sheer weariness of speculation that we choose a starting-point, behind which stretches the nebulous haze of agnosticism.

Supposing, then,—with the fullest confession of the speculative nature of the supposition—that the elements arose by the differentiation of protyllic vortices, or by some analogous mode of genesis, we have to note that the differentiation was determinate. Under the given conditions of interaction (whatever they may have been) just these seventy or eighty definite and determinate groupings of protyle which we term the elemental atoms came into being. Nor is their interaction less determinate; and here we leave the tenuous atmosphere of speculation for the more solid ground of observation and experiment. The elements form definite compounds. No one, in the absence of observation or analogy based on practical experience (his own or that of others), could foretell what new characters a compound, resulting from the chemical union of well-known elements, would possess. The nature and properties of complex chemical substances appear to be the results of a determinate synthesis. Science can tell us the antecedent conditions and the consequent products,—so much carbon and sulphur under such and such conditions of temperature and pressure, giving so much carbon disulphide vapor which will condense under other conditions of temperature and pressure to a colorless liquid with a high refractive index. But science cannot tell us why this is so. Its constraining force of chemical attraction, if regarded as more than a measure of the interaction actually observed, is a metaphysical conception. It has no place in the chain of antecedents and sequents but underlies them as their *raison d'être.* And if we accept the metaphysical implication, it is here that we must postulate the source and origin of the determinism that is observed in the phenomenal sequence.

The relatively homogeneous substance, rendered fluid by aqueo-igneous fusion, from which by slow cooling the constituent minerals of granite—its orthoclase, its mica, its quartz, and so forth—crystallise out, exemplifies the process of differentiation by which the Plutonic rocks within the earth's crust originate. And during every stage of the process there is interaction between the developing determinate crystals and the differentiating magma which forms their environment. Count Bournon described some seven hundred different forms of crystallised calcite. To what extent more recent research has diminished or increased this number matters not for our present purpose. Science bids us believe that for each of the many different forms there are different antecedent conditions. The form is the index of stability under the play of its special environment. And the close association between interaction and differentiation is here again exemplified. But it is unnecessary to dwell longer on the lessons of determinate differentiation which the chemical compound and the crystal teach us with such unmistakable clearness. The lessons of mountain and valley, as interpreted by physical geology, are of a different kind. There is a sense in which every product of evolution may truly be called determinate. Given the slope of the land, its constituent strata, their hardness and resisting power, their jointing cleavage and so forth; given also the denuding forces which play upon its surface, together with the measure of their intensity; and the interaction of denudation and structure determine to a nicety every contour of hill and vale, bay and promontory. Thus is the differentiation of the physical features of the earth's crust brought about. Thus is the face of the continent carved into sculptured relief. But it is obvious that we have here but little of that intrinsic determination which gives to the chemical compound its definite properties, or finds expression in the facetted form of the crystal. We must therefore carefully distinguish two modes of differentiation; that in which the determinism is predominantly intrinsic and that in which it is mainly extrinsic; that which is chiefly due to determinate synthesis, and that which is chiefly the result of free interaction; that which is exemplified by the growing crystal, and that which is typified by the deepening valley, or by the circling planets of the solar system.

So much must suffice for the differentiations and interactions in the inorganic sphere. We now pass on to the organic. The origin of protoplasm is the battle-ground of the creeds. All that science can tell us is that the antecedent conditions of its genesis are unknown. But with so much that is unknown to science it surely ill beseems us to build too much upon this. It is but our familiarity with the genesis of the crystal that affords any justification for the supposition that this is the outcome of a natural evolution while the genesis of protoplasm is not so. Science can tell us in the one case no more than in the other the *why* of its existence; while even of the *how* of crystalline architecture science can only say that, given such and such conditions, it appears. Of protoplasm we may likewise say that under certain conditions, at present unknown, it appeared. Those who would concentrate the mystery of existence on the pin-point of the genesis of protoplasm, do violence alike to philosophy and to religion. Those who would single out from among the multitudinous differentiations of an evolving universe this alone for special interposition would seem to do little honor to the Divinity they profess to serve. Theodore Parker gave expression to a broader and more reverent theology when he said: "The universe, broad and deep and high, is a handful of dust which God enchants. He is the mysterious magic which possesses" —not protoplasm merely, but— "the world."

Theological implications do not, however, here concern us except as the expressions of that broader philosophy of our day which sees in the origin of protoplasm an example of the process of differentiation which is characteristic of evolution at large. Assuming therefore that protoplasm originated through determinate synthesis, under conditions at present unknown, it is clear that its characteristic properties are primarily of what we have termed the intrinsic type. Like the properties of other chemical compounds they are its natural dower. But they are preeminently such as afford the fullest and freest opportunities for that interaction which leads to differentiation of the extrinsic type. Its capacity of increase by assimilation, its instability combined with a power of recuperation, its tendency to corpuscular division, combined with a tendency for the corpuscles or cells to become incorporated in a complex organism, wherein not only is there a differentiation into diverse constituents, but a constant interaction among the several parts and with their environment; all this affords opportunity for a continuous series of transformations and redistributions of energy, which give to living beings their wonderful plasticity and their extraordinary variety. Seeing therefore how closely inter-related are the intrinsic properties of protoplasm and the extrinsic interactions which their special character renders possible, it is scarcely a matter for surprise that biologists find it a matter of exceeding difficulty to assign to the two modes of differentiation, intrinsic and extrinsic, their respective rôles in the drama of organic evolution.

That this evolution is determinate, in the widest sense of the word,—that every stage in the development of any organism could be traced, had we sufficient knowledge and mental grasp, to assignable antecedents—is an assumption which the science of biology must accept, or forfeit its claim to be regarded as a science. But whether, or in what degree, those complex differentiations which we term "varieties" are due to intrinsic tendencies is a question concerning which there is much diversity of opinion. Mr. Henslow has adduced a number of instances, among plants, which show that changes of soil and climate induce special and often adaptive alterations in the character and habit of the roots, leaves, and other parts. The well-known and oft-quoted observations of Schmankewitsch seem to show that transference of certain brine-shrimps to water of different salinity induces in their offspring a change of form in the tail-lobes and a change of character in the spines which they bear. Abundant illustration might be given of such modifications in developing organisms subjected to a new environment—modifications of a special kind and of a determinate nature. It is true that we are ignorant how far, in the absence of natural selection leading to the survival of coincident variations, these modifications of structure are inherited. But so far as the individual is concerned the determinate character of these differentiations is noteworthy. Still all we can say is that they seem to be due to some internal power of responding to external conditions in a special way. How that internal power was developed we cannot pretend to know.

The effects of interaction are admirably illustrated by the process of fertilisation on which modern research has thrown much light and is destined, we may hope, to throw more. Taking one of the higher multicellular animals as an example it has been shown that, within the nucleus of the cell, remarkable changes occur during the process of division. A thread of deeply-staining substance breaks up into a number of curved rods,—the number being constant for the particular organism,—and these, grouping themselves in a definite figure, split along their length, thus giving two sets of curved rods, one set for each daughter nucleus, in the two cells which arise by division. But in the unripe reproductive cells the deeply-staining substance is arranged in so-called tetrads or groups of four units, there being half as many tetrad groups as, in the ordinary cells of the organism, there are curved rods. These immature reproductive cells undergo divisions, during which each tetrad is first halved, giving a dyad, and then halved again, giving a single unit. And in this way each ripe or mature reproductive cell contains half as many of these units of deeply staining substance, as is characteristic of the cells of the organism. In the process of fertilisation the reproductive cell from the male parent unites and fuses with that from the mother organism ; a new nucleus is formed by grouping of the units ; the normal number for the species is reconstituted ; and by the interaction of these units the course of development of the organism which results from the fertilisation of the ovum would seem to be guided.

But the offspring even of the same parents are not all precisely alike. Partly by differences of the inherited substance, partly by differential interaction, they vary around a common mean. And as they develop they are subject to those wider interactions among each other, and in relation to their environment, which Darwin summarised in the phrase, the struggle for existence. The weaker and the less fit are eliminated. Natural selection plays its part. The unfavorable varieties die without mating ; the fittest survive to procreate their kind. These differentiations are lost to the race; those are perpetuated. Evolution in the organic sphere is determinate ; but, in the current interpretation, it is of the valley type. The elimination which results in natural selection is the denudation of the continent of life. Those organisms which, from superior resisting power, outlive its repeated shocks, stand forth, like the hills, as survivals in the organic world. The more yielding types have succumbed; one must supply by inference the missing material which once occupied the valley gaps.

But is the determinate evolution of organic life entirely of this valley type? Have we left the intrinsic determination of the crystal type far behind? Has determinate evolution through indefinite interaction altogether superseded determinate variation through the subtle compounding of intrinsic tendencies? We do not know. Some biologists, whose confidence in the all-embracing efficacy of natural selection is equal to every strain, deny the occurrence of determinate variations; which is bold. Others demand more evidence; which is not unreasonable. Others again contend that variation is rendered determinate through the inheritance of modifications acquired by the parents; which is open to question. Yet others assume that intrinsic variations, definite in direction, are the main determinants of organic progress; which is speculative. Some combine two or more of these hypotheses, and see in organic evolution the result of the co-operation of diverse factors; which is a compromise. To those who dislike indefiniteness of conclusions such diversity of opinion is distasteful. To those who love the din of controversy it affords the pleasing spectacle of contending parties. In any case, in the present position of biological science, it would seem to be inevitable. And we must leave the problem open for the science of the future to solve. This only may be said, that granting the determinate evolution which natural selection helps us to explain, there remain cases which, to say the last of it, present difficulties to the candid inquirer. That all the varieties of butterfly coloring and ornamentation, that all the forms and tintings of molluscan life, that all the pencillings of birds' plumage, that all the complications of mammalian tooth-structure,—that these and many other differentiations which are met with in the organic world, are due solely to the action of natural and sexual selection, demands a faith which verges on credulity. And bold must be he who dares to deny that none of these can be due to an intrinsic determinate synthesis such as that to which the protoplasm, whereof these marvellous structures are the products, owes its origin. But that modesty which is so conspicuous a trait in the modern biologist, should prevent him not only from denying but also from asserting, in the absence of definite evidence, that determinate synthesis is a factor in organic variation.

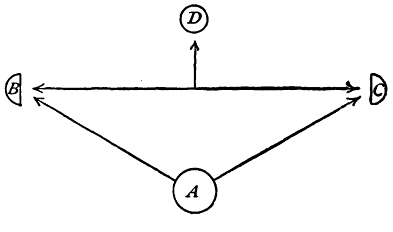
It is clear, however, that if natural selection be an important agent in progress, and if the variations which are presented to its action in any existing organism be determinate, they may still owe their definite nature to a process of selection. For the very fact that certain variations are selected for survival may foster further variations in a similar direction and give them the appearance of being intrinsically determined. While other variations are checked by the elimination of the organisms in which they occur, these are allowed free play. The existence of a tendency to vary in certain directions cannot, therefore, of itself be taken as sufficient evidence that this tendency is independent of natural selection, since variability in special lines is itself subject to selection. It must be shown that selection is either inoperative, or incapable of producing the particular differentiation in question, before biologists of the school of Mr. Wallace and Prof. Weismann will admit that determinate variation is of the crystal type. Enough has, however, been said to show how exceedingly complex is the problem with which we have to deal, and to justify an attitude of suspended judgment.

When we add to the difficulties which arise from the present and past effects of that interaction with the environment which renders natural selection possible, the further difficulties which arise from the interaction of the constituent parts within the organism itself we realise yet more fully the extreme complexity of the problem of organic evolution. That every cell in the living animal is in vital relation with its companion constituents of the body corporate, is too familiar a fact to need illustration. We may more profitably adduce an example from the early stages of development of the little sand-lance or Amphioxus. The fertilised egg-cell undergoes division first into two, then into four, eight, sixteen cells, and so on, in the successive stages of cleavage by which the constituent corpuscles of the embryo are subdivided. Now if we fix our attention on the first division of the fertilised ovum into two cells, we have here the initial step in a process of continuous differentiation. Each of these two is the parent of half the constituent corpuscles of the completed organism. But this normal differentiation would seem to be dependent upon the continued interaction of the first two cells and their subsequent products. For if, so soon as the ovum has divided, it be shaken somewhat roughly in water, so as to separate the two cells and thus prevent their interaction, each separate cell divides and subdivides in such a way as to form a complete and perfect, but abnormal, embryo, differing from the normal only in the fact that it is half the usual size. The fate of the two cells is therefore dependent on the presence or absence of their interaction. If they remain in their normal relation, each gives origin to half an embryo: if they are separated and interaction be prevented, each gives origin to a complete embryo of half the normal size. And the lesson of the Amphioxus is one that the study of organic development teaches in many forms but all leading to one conclusion; that protoplasmic differentiation is inseparably connected with interaction. It is here that the analogy of the crystal completely fails in adequacy and reach. For the crystal is relatively stable and unyielding. Some interaction there is between the developing mineral and its environment; but it is comparatively slight. Protoplasm, on the other hand, is relatively unstable and plastic. Its capacity for interaction is a characteristic property, essential to its vitality and its peculiar modes of differentiation. If therefore determinate variations exist, they must differ from the variational forms of calcite certainly in no less degree than the properties of protoplasm differ from those of crystalline carbonate of lime. The source of differentiation may be in greater or less degree intrinsic; but it must surely assume a form indefinitely more complex than anything of which the mineral kingdom gives us any premonitory indication.

* * *

In passing to the metaphysical implications which underlie the scientific study of evolution, we must remember that science endeavors with more or less success, but not without many confessions of ignorance, to describe phenomena in terms of antecedence and sequence. Metaphysics, on the other hand, accepting the sequences ascertained by science, seeks, not only to explain the manner of their connexion, but to bring them into fruitful union with conclusions reached in other spheres of thought. The biologist as he patiently traces the developmental history of this or that organism, or of life on the surface of our planet, has no occasion to consider what relation his inquiries bear to those of the philosopher who seeks to explain the genesis of experience. It suffices for him to describe the phenomena as occurrences in a world, the objective reality of which he accepts with perfect confidence. The dualism of analysis forms the platform from which he starts, and it is no part of his business to examine its foundations. He leaves all this to the philosopher. And it now remains for us to see whether that differentiation and interaction which we have seen to lie at the very root of our conceptions of evolution, serve in any way to supplement the conclusions to which we have already been led. For if the assumptions of metaphysics are to have any validity, they must keep in close and vitalising touch with the generalisations of science.

Let us, at the risk of offending those for whom such representations are rather a hindrance than a help, throw into diagrammatic form what appears to be the essence of the evolution process :



The lower circle *A* stands for the relatively homogeneous substance prior to the differentiation which is indicated by the ascending divergent lines. The products of differentiation are represented by the semicircles *B*, *C*, on either hand, and the result of their mutual interaction by the upper circle *D*, which represents a new and more complex unit. Let *A* for example represent the fertilised ovum of

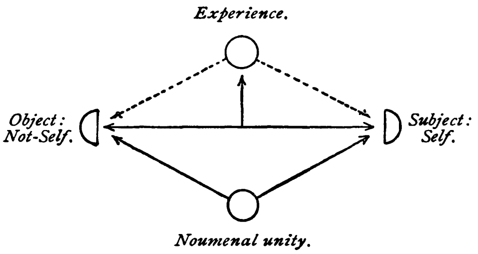
Amphioxus, and *B*, *C* the differentiation involved in repeated cell-division. Then by the mutual interaction of these differentiated products a new unit *D*, the developed Amphioxus, is produced. Such a scheme of course sets forth rather the type to which evolution ideally conforms than what is actually observed in any particular case. Science, as we have seen, is unable to trace back the chain of antecedents to the homogenous substance which is the ideal starting-point. If we take the diagram to illustrate the differentiation of the fertilised ovum of Amphioxus into two differentiated and interacting cells, we must not suppose that the fecundated egg with which we start is more than relatively homogeneous. Its nucleus is itself the product of the union of the already-differentiated nuclei of parental cells, the interaction of which is clearly shown by their behavior within the fertilised ovum. Nay more, the genetic continuity of protoplasm opens up to our mind's eye a vista down an indefinitely prolonged avenue of differentiations and interactions stretching far away back into long distant times. But every step in the evolutionary process was taken in relative conformity to the scheme which the diagram is intended to represent. Innumerable differentiations are now taking place concurrently; and the interactions of their products present a bewildering complexity which we can only grasp piecemeal, by fixing our attention now on this and now on that relationship between the interwoven threads in the fabric of the phenomenal universe. It is only by generalisation, and by carrying to its ideal limit the conception which thus takes definite form, that we reach the simple but comprehensive scheme of a diagram. It thus becomes an abstract plan or formula which may be applied to any concrete example of differentiation. Whether we take the supposed evolution of any two elements from protyle, of the sun and the earth from fire-mist or meteoric dust, of the earth and the moon as interpreted by Mr. George Darwin, of the crystal from its solution, of the orthoclase felspar from the granitic magma, of the first speck of protoplasm from the medium which held its constituent elements, of each pair of daughter-nuclei from the nucleus of the parent cell,—everywhere we find that the formula fits the facts; everywhere we see diverse manifestations of the same fundamental process—differentiation accompanied by interaction.

It may be said that the coalescence of the products of differentiation is by no means a universal fact. No doubt, if we assume hydrogen and oxygen to be the differentiated products of protyle, they may, under the appropriate conditions, combine to form water. But the differentiated cells of the fertilised Amphioxus ovum remain separate and do not coalesce; and ever since the moon and earth were torn asunder, they have remained apart and have not again combined to form a new and more complex unit. Unquestionably the continuance of direct interaction depends on circumstances and the conditions of the case. As we have seen however in the development of Amphioxus the two cells, though they do not coalesce, continue to influence each other in such a way that under normal conditions they form parts of a more complex whole, the development of which is determined by their interaction. And the same is true of the earth and the moon. They form an interacting system, and this is all that the circle *D* is intended to represent. Still there are many cases in which the differentiated products become relatively independent of each other. The two daughter-amœbæ into which the parent organism divides, go each on its several way, and do not interact to any appreciable extent. And in innumerable cases the products of one differentiation react on the products of another differentiation. To attempt to represent this in diagrammatic form would involve a complexity which would be so bewildering as to defeat the object of a schematic formula. Let the diagram therefore be taken to represent the general fact of differentiation and the not infrequent interaction of the differentiated products under the appropriate circumstances. In brief let it stand for the two root-ideas of the conception of the evolutionary process, which we have seen to be first, differentiation, and secondly, the interaction of the differentiated products.

What then is the bearing of this conception on the problem of the genesis of experience? We have seen how, under the polarising influence of analysis, experience assumes a dual aspect, with its objective phenomena and their underlying causal connexions on the one hand, and its correlative subjective phenomena and their underlying causal connexions on the other hand. But we have also seen that this analysis of experience is insufficient to account for its genesis. Analytic dualism may enable us to distinguish subject and object as diverse aspects of experience. But it gives no explanation—it does not even afford the germ from which may be developed an explanation—of the manner in which this experience with its diverse aspects originates. Hence we assumed a persistent and independent cause, regarding it as a postulate of rational thought. On this assumption experience is the effect of the interaction of the self and the not-self. We may still say with Huxley, however, that "neither of the existence of 'self,' nor of that of 'not-self' have we, or can we by any possibility have, any such unquestionable and immediate certainty as we have of the states of consciousness which we consider to be their effects. They are not immediately observed facts, but results of the application of the law of causation to those facts. Strictly speaking, the existence of a 'self' and of a 'not-self' are hypotheses by which we account for the facts of consciousness. They stand upon the same footing as the belief in the general trustworthiness of memory, and in the general constancy of the order of nature—as hypothetical assumptions which cannot be proved, or known with that highest degree of certainty which is given by immediate consciousness; but which, nevertheless, are of the highest practical value, inasmuch as the conclusions logically drawn from them are always verified by experience."

But hypothetical assumptions should be able to justify not only their efficacy but their origin at the bar of reason. And the philosophy of evolution appears to afford such justification of the assumed independence and interaction of self and not-self. Applying our evolutionary formula in this region of metaphysical thought we find that it is not less helpful here than it is in the field of scientific inquiry. Evolution is found to supply a key not only to the problems of science but also to those of philosophy. A monistic interpretation on a single comprehensive plan is reached. Analytic dualism is supplemented by the dualism of differentiation which may be traced downwards into the monistic unity from which the differentiated products have arisen. This monistic unity is represented in our diagram by the lower circle *A*, which differentiates into the self and the not-self, *B* and *C*, from the interaction of which arises the sphere of experience *D*. The self and the not-self have all the independence of differentiation together with the unity which is implied in their derivation from a common source. And the manner of their interaction, (being dependent on a wide variety of circumstances due to multitudinous differentiations within the not-self, with answering diversities in the self), affords ample opportunity for all the complexities which are disclosed by analysis in the sphere of sense and of thought. For here too the interaction only takes place under the appropriate conditions which we term the occasions of experience.

It only remains to indicate as briefly as possible the relation which the diagrams of the earlier part of this essay, representing the dualism of analysis, bear to that which formulates the process of evolution with its dualism of differentiation. It consists essentially in the identification of the subject and object of analysis with the self and not-self of differentiation. Combining our diagrams we have the following scheme:



The lower circle represents the monistic unity prior to dualistic differentiation; hence arises the self on the one hand and the not-self on the other, which by their interaction give origin to experience, including both sense and thought. The dotted lines express the analysis of experience into object and subject coterminous with the not-self and the self of differentiation. But whereas the subject and object of analytic dualism are dependent on the occasionalism of experience, the self and the not-self are persistent so long as the differentiation holds.

The philosophy of evolution thus extends the conception of metaphysical cause which we reached in the foregoing essay. The differentiation of the cosmos, and the interaction of its differentiated products, are to be regarded as the manifestations, under conditions of time and space, of an underlying activity which is its cause. For the time and space elements are attributes of the phenomenal manifestation, not of the noumenal cause. It is true that, as human beings with limited powers of grasping the nature of metaphysical existence, we are forced to speak of differentiation as manifested in time and of interaction as manifested in space. But if the conclusions reached in the last essay are valid, the metaphysical cause, as such, is timeless and spaceless,—eternal and infinite. How this can be perhaps passes the wit of man to conceive; for to do so it seems necessary to transcend the conditions under which our experience is given. We cannot, however, discuss the question here; and it must suffice to say that the underlying metaphysical activity, as cause, is neither the product of evolution nor its precursor in time; it is that timeless omnipresent existence in and through which evolution is rendered possible.

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